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(54) Title of the invention: TWO-WAY DUPLEX COMMUNICATION METHOD THROUGH SATELLITE.

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SPECIFICATIONS

1. Title of the invention:

Two-way Duplex Communication Method through Satellite.

2. Field of Patent Claims:

A two-way duplex communication method through satellite:

performs a two-way communication for contacting using radio waves for a television picture transmission through a satellite transmitted a television picture signal;

in a picture signal transmitting side, it is synchronized at a horizontal scanning period of a picture signal, a communication carrier is intermittently added into a picture signal transmission band at a prescribed level and then is transmitted toward a satellite, a communication carrier from a satellite is alternatively intermittently received with the said intermittent transmission;

in a picture signal receiving side, a communication carrier is continuously transmitted to a satellite at a prescribed level difference lower then the above-mentioned prescribed level, the said communication carrier from a satellite is intermittently received only during the period of intermittent transmission at a picture signal transmitting side;

in the above-mentioned satellite, the above-mentioned communication carriers from the picture signal receiving side and from the picture signal transmitting side respectively received them are mixed keeping the above-mentioned prescribed difference, the said mixed communication carriers are transmitted toward, at least, the picture signal transmitting side and the receiving side, therefore, a continuous two-way communication for contacting through a satellite can be performed at the same time.

3. Detailed explanation of the Invention:

[Technical Field of the Invention]

The present invention relates to a two-way duplex communication method through satellite capable of occasional performing a two-way communication for business contacting to be performed by a communication carrier with a single frequency multiplexed at radio waves for a television picture transmission through a satellite transmitted a television picture signal such as a broadcasting satellite or the like in any way, especially, a two-way duplex communication can be reached by a cheap device with a comparatively simple constitution.

[Outline of the Invention]

It is desired that the present invention at the picture signal transmitting side synchronizes communication carrier of a stationary level during a horizontal scanning period and then intermittently transmits them; at the picture signal receiving side continuously transmits a communication carrier with the same frequency at a lower prescribed lever difference then a normal level; at a satellite, mixes communication carriers from the picture signal receiving side and from the picture signal transmitting side keeping a prescribed difference, and transmits them again; intermittently receives a communication carrier of a partner side in an alternative way to make it possible to perform a two-way communication for business contacting at the same time by a communication carrier with a single frequency multiplexed at radio waves for a television picture transmission through a broadcasting satellite. An inconvenience of a press talk format such as that in prior technique can be removed and a two-way duplex communication of 7 KC can be simply performed at two ways without obstacles by an intermittent reception of a mixed carrier with a single frequency keeping a

level difference of about 10db during a horizontal scanning period.

[Technique of the Prior Art]

Generally, a telephone line for business contacting through a broadcasting satellite (BS) (order wire) OW is constituted by establishing OW carrier to a position with a higher frequency 13, 3 MHz then a central frequency of a BS channel for television picture transmission, and modulating this carrier from an audio signal to FM. Consequently, OW carrier has only one wave, therefore, in the prior art when one station performs transmission during a business contact communication between the both: transmitting and receiving ground station of picture transmission, the other station can perform only reception; or oppositely, so-called press talk format is used, therefore, a two-way duplex communication which performs an occasional communication in two ways such as during a usual telephone conversation is performed, and there is a problem that a quick good understanding can not be reached.

Thus, the above-mentioned problem is similar even in a business contact communication between both transmitting and receiving ground stations when a television satellite relay is performed not only through broadcasting satellite performed a television satellite broadcasting and through a general communication satellite.

[The problem which the present invention intends to solve]

Thus, only a single frequency is distributed into OW carrier through satellite, therefore, if a transmitting receiving station transmits conversation at the same time using OW carrier with the said single frequency, it is mutually interfered, or weak radio waves are masked by strong radio waves, and it is impossible to

perform a satisfying communication in two ways. As a means for solving to the problem is that an audio frequency bands are mutually changed by an occurred high frequency, a respective transmission time is distributed in a transmitting-receiving station, a so-called time distribution multiplication (TDMA) format is developed. However, in a communication between ground stations through satellite a delay time of radio wave based on a necessary time with a long radio wave arrival is remarkably big 0.3 second for going and return, therefore, a mutual transmission and reception in each station are not good coordinated, and an extremely difficult and expensive device is required for TDMA control, therefore, it is difficult to use a TDMA format in a two-way duplex communication through satellite.

[Means for solving to the problem]

Consequently, the purpose of the present invention is to solve the above-mentioned problems of the prior art and to provide a two-way duplex communication method through satellite which can perform a communication in occasional option at a ground station by a cheap device with a comparatively simple constitution using a communication carrier with a single frequency.

Namely, in accordance with the present invention, a two-way duplex communication method through satellite performs a two-way communication for contacting using radio waves for a television picture transmission through a satellite transmitted a television picture signal; in a picture signal transmitting side, it is synchronized at a horizontal scanning period of a picture signal, a communication carrier is intermittently added into a picture signal transmission band at a prescribed level and then is transmitted toward a satellite, a communication carrier from a

satellite is alternatively intermittently received with the said intermittent transmission; in a picture signal receiving side, a communication carrier is continuously transmitted toward a satellite at a prescribed level difference lower then the above-mentioned prescribed level, the said communication carrier from a satellite is intermittently received only during the period of intermittent transmission at a picture signal transmitting side; in the above-mentioned satellite, the above-mentioned communication carriers from the picture signal receiving side and from the picture signal transmitting side respectively received them are mixed keeping the above-mentioned prescribed difference, the said mixed communication carriers are transmitted toward, at least, the picture signal transmitting side and the receiving side, thus, a two-way communication for contacting through satellite can be performed at the same time.

[Operation]

Consequently, a two-way duplex communication through satellite which can perform a communication for business continuation at a mutual terrestrial station in occasional option, can be realized by a device with a comparatively simple constitution using a communication carrier with a single frequency.

[Description of the preferred embodiment]

The preferred embodiment will be described further below according to the present invention referring to the drawings.

In a BS channel for television picture transmission in a broadcasting satellite, now, a television picture signal specter is spread in a picture transmission band with a width of 27 MHz as shown in FIGURE 2, OW carrier is established near the upper end of this band separating from the center of the band for 13, 3 MHz, and then is FM modulated from an audio signal for

business contacting. A level of this OW carrier is set to 24dB that is lower then the maximum signal level of a picture signal, and there is no obstacle in a picture signal.

An example of an outline constitution of a broadcasting satellite picture transmission system included a communication line for business contacting performed a two-way duplex communication through satellite using the above-mentioned OW carrier is shown in FIGURE 1.

In a broadcasting satellite picture transmission system with an outline constitution shown in FIGURE 1, in a picture signal transmitting station shown in the left of FIGURE 1 a picture input is supplied into a picture modulator (MOD) 2, a picture carrier is frequency modulated. Its modulated output carrier is conducted to an up converter (U/C) 3, carrier frequency is frequency changed and then supplied to a transmitter (Tx) 4, and then supplied to a synthesizer 9 such as duplex. OW audio input is supplied into OW modulator (MOD) 5, OW carrier with a frequency separated for 13, 3 MHz from the center of a picture transmission band as it was shown above, is FM modulated. This modulated output OW carrier is conducted to a gate circuit 6, and then is generated being synchronized with a horizontal synchronizing signal of a video input by a gate generator 1 in a picture transmission system, for example, a gate signal, which switches ON the first half of a horizontal scanning period, is added, a modulated output OW carrier is intermittently passed only during the said first half of a horizontal scanning period, a carrier frequency is frequency modulated by an up converter (U/C) 7, and then is supplied into OW transmitter (Tx) 8, and then similarly supplied into the synthesizer 9. In the synthesizer 9, micro waves of 14 GHz respectively frequency modulated by a carrier picture signal and modulated OW carrier are

synthesized and then are transmitted toward a broadcasting satellite 17 as an increase circuit through a transmitting-receiving parabolic antenna 16.

On the other hand, in a picture signal receiving station shown in the right of FIGURE 1 OW audio input is supplied into OW modulator (MOD) 21, OW carrier with a necessary frequency corresponded to OW carrier in a picture signal transmitting station has a carrier level of 10db that is lower than OW carrier level in the picture signal transmitting station, and it is continuously FM modulated from OW audio input. A carrier frequency is frequency changed by the up converter (U/C) 20 and then is the same carrier frequency as that in the picture signal transmitting station, then is supplied into the OW transmitter (Tx) 19, then is directly supplied into the transmitting-receiving parabolic antenna 18, and similarly then is sent to the broadcasting satellite 17 as an increase circuit.

Consequently, a modulated OW carrier in antenna input of the said transmitting station is intermittently sent only during the first half of a horizontal scanning period, corresponding to a horizontal scanning period 63, 5 μs of an input picture signal in the picture signal transmitting station shown in FIGURE 3 (a); on the other hand, a modulated OW carrier in antenna input of the picture signal receiving station is continuously sent at OW carrier level of 10db that is lower than OW carrier level in the picture signal transmitting station as shown in FIGURE 3 (c). As a result, in a receiving part of the broadcasting satellite 17, a modulated OW carrier with the same frequency from both transmitting and receiving stations is mixed keeping a prescribed OW carrier level difference of about 10db at the state when a micro wave receiving output intensity from the both transmitting and receiving stations of picture signal is arranged,

the level is intermittently increased till 10db during a horizontal scanning period as shown in FIGURE 3 (e). Also, a mixed output modulated OW carrier of wave form followed a change of a level with a low frequency that is not more then an audibility frequency corresponded to an extremely small slipping of OW carrier frequency in the both transmitting and receiving stations is obtained. In the broadcasting satellite 17, the said mixed output modulated OW carrier sent back to both the transmitting and receiving stations by carrying it on the micro wave of the outgoing circuit of 12 GHz, for example, by superposing it on the picture signal transmission band through TWT amplifier similarly to that in the picture signal transmitting station.

However, as shown above, a delay of radio wave arrival of 0, 3 second for going and return occurs in the picture signal transmission through satellite, therefore, a receiving output picture signal in both the picture signal transmitting and receiving ground stations generates a correspondent time delay for input picture signal in the picture signal transmitting station shown in FIGURE 3 (a), as shown in FIGURE 3 (d). A time delay based on the said radio wave arrival delay similarly occurs in two ways of picture signal and OW audio signal, therefore, the above-mentioned level increase period of receiving output modulated OW carrier in both the transmitting and receiving ground stations is matched to the first half of a horizontal scanning period in the receiving output picture signal, as it is clear by contrasting FIGURE 3 (d) with FIGURE 3 (e).

Consequently, in the picture signal receiving station the microwave of the outgoing circuit of 12 GHz taken out from the transmitting receiving parabolic antenna 18 is supplied to the distributor 23, after a frequency change was applied conducting

to the down conductor (D/C) 22, and is separated from a carrier picture signal component and a modulated OW carrier. The carrier picture signal component is supplied into a picture demodulator (DEM) 24, a demodulated output picture signal is taken out, and a horizontal synchronizing signal of this receiving output picture signal is supplied to the gate generator 25, the gate signal which sets the first half of a horizontal scanning period to ON is generated and then is added to the gate circuit 26. However, a modulated OW carrier of a signal waveform shown in FIGURE 3 (e) and taken out from the distributor 23 is supplied to the gate circuit 26, is gated from the above-mentioned gate signal, and a high level period in a signal waveform shown in FIGURE 3 (e) is drawn out. A modulated OW carrier of this high level period is FM modulated carrier with a level difference of about 10db including FM modulated OW carrier of the same frequency of 10db which is lower in the picture signal receiving station into FM modulated OW carrier from the picture signal transmitting station, therefore, if the above-mentioned gate output FM modulated OW carrier is FM demodulated conducting as it was to the OW demodulator (DEM) 27, OW audio of the picture signal receiving station itself is masked and doesn't appear in a demodulated output, only the OW audio signal from the picture signal transmitting station is intermittently taken out.

On the other hand, in the picture signal transmitting station the microwave of the outgoing circuit of 12 GHz taken out from the transmitting receiving parabolic antenna 16 is supplied to the distributor 12, after a frequency change was applied conducting to the down conductor (D/C) 13, and is separated from a carrier picture signal component and a modulated OW carrier.

The carrier picture signal component is supplied into a picture demodulator (DEM) 11, a horizontal synchronizing signal of a demodulated output picture signal is supplied to the gate generator 10, the gate signal, which sets the second half of a horizontal scanning period to ON, is generated and then is added to the gate circuit 15.

However, a modulated OW carrier of a signal waveform shown in FIGURE 3 (e) and taken out from the distributor 12 is supplied to the gate circuit 15, is gated from the above-mentioned gate signal, and a low level period in a signal waveform shown in FIGURE 3 (e) is drawn out. A modulated OW carrier of this low level period is only a modulated OW carrier from the picture signal receiving station and has a carrier level of about 10 db lower then a usual OW carrier level, but there is enough remainder in C/N of the OW circuit, therefore, OW audio signal from the picture signal receiving station is intermittently taken out and can be heard good enough.

Thus, as mentioned above, a respective modulated carrier in both the picture signal transmitting and receiving stations, one and another, are intermittently taken out at a horizontal scanning frequency of 17, 75 KHz, but this intermittent period exceeds enough a normal audibility frequency band, a demodulated output audio signal till 7, 875KHz is obtained by a sampling principle, therefore, a good audio quality can be obtained as an audio signal for business contacting.

Thus, in a two-way duplex communication according to the present invention, a ground station intermittently transmitted OW carrier and a ground station continuously transmitted, of course, can be opposite, to that in case shown in FIGURE 1. However, OW carrier is intermittently sent from the picture signal receiving station as shown above, therefore, OW carrier

from the picture signal receiving station intermittently sent, being synchronized with a horizontal synchronizing signal of a receiving output picture signal delayed for approximately 0, 3 second from input picture signal in the picture signal transmitting station, arrives to the picture signal transmitting station being delayed for 0, 3 second; a positive reason in a clear technique is not found at a special performance in the picture signal transmitting station side capable of an easy performing an intermittent transmission synchronized with a picture horizontal synchronizing signal of the said OW carrier.

[Result of the Present Invention]

As it is clear from the above-mentioned explanation, in accordance with the present invention, there is no inconvenience of press talk format communication in a communication line for a business contacting through satellite which distributes not only one frequency, as it was in the prior art, also, a two-way duplex communication through satellite can be easy realized using a cheap device with a comparatively simple constitution not by TDMA control which requires an expensive and difficult control device; a quick good understanding between both the transmitting and receiving ground stations of a picture signal is achieved, and a remarkable result can be obtained in a program service by switching between stations of satellite broadcasting.

4. Brief description of the drawings:

FIGURE 1 is a block diagram showing an example of outline constitution of a two-way duplex communication through satellite according to the present invention method;

FIGURE 2 is a characteristic curve diagram showing specter distribution characteristics of a broadcasting satellite picture signal transmission channel;

FIGURE 3 (a) ~ (g) is a signal wave form diagram orderly showing an each part operation wave form in an outline constitution shown in FIGURE 1.

[Description of Numbers]

1, 10, 25 are gate generator;
2 is an image modulator;
3, 7, 20 are up converters;
4 is an image transmitter;
5, 21 are OW modulator;
6, 15, 26 are gate circuits;
8, 19 are OW transmitters;
9 is a synthesizer;
11, 24 are image demodulators;
12, 23 are distributors;
13, 22 are down converters;
14, 27 are OW demodulators;
16, 18 are sending-receiving parabolic antennas;
17 is a broadcasting satellite.

FIG.1

an example of outline constitiution of a two-way duplex communication through satellite according to the present invention method;

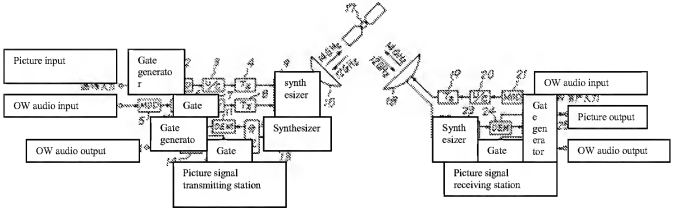

FIG.2

A specter distribution characteristics of a broadcasting satellite picture signal transmission channel

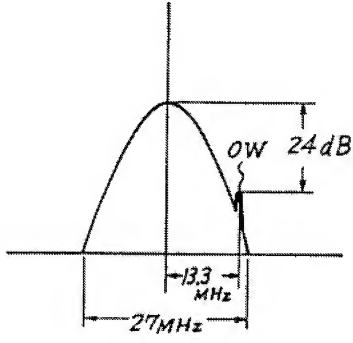

FIG.3

A waveform diagram showing an each part operation in an outline constitution shown in FIGURE 1.